

*One Conspirator or
Two in the Death of the
Coal Miner's Daughter*

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Coal's Detractors Say

=> Its dirty

=> Its production is dangerous

=> Its use is environmentally unsafe

=> Its use is unnecessary because of the availability of alternatives

Coal's Supporters Say

=> Yes, its dirty

=> Much less dangerous to produce now

=> There are methods to reduce its harm to the environment

=> No economically viable alternatives because coal is

CHEAP and PLENTIFUL!

Debate Regarding Coal's Future

Can/Will alternatives to coal “naturally” replace it (Creative Destruction)?

or

Is coal's economic advantage so great that it can only be legislated/regulated out of existence/use?

Providing Direct Evidence is Difficult

Coal from where?

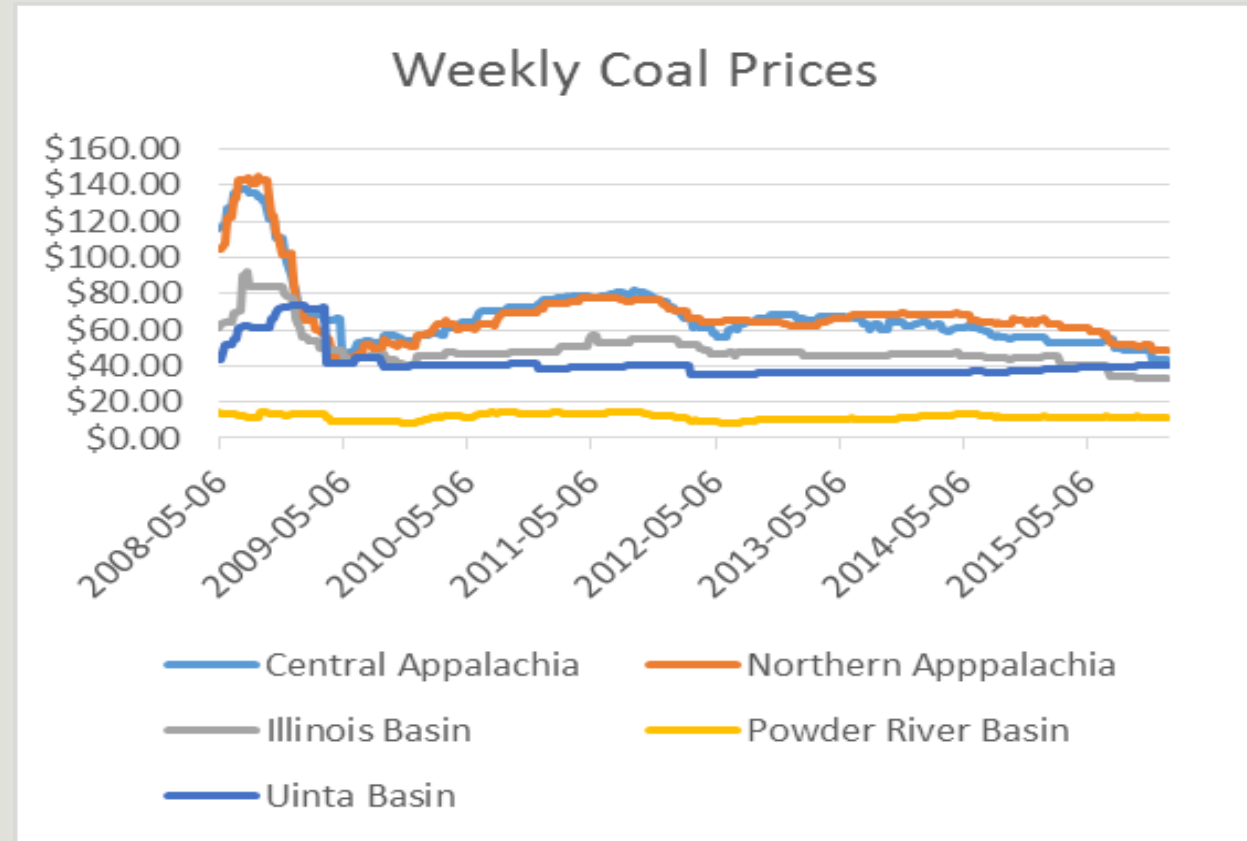
Central Appalachia

Northern Appalachia

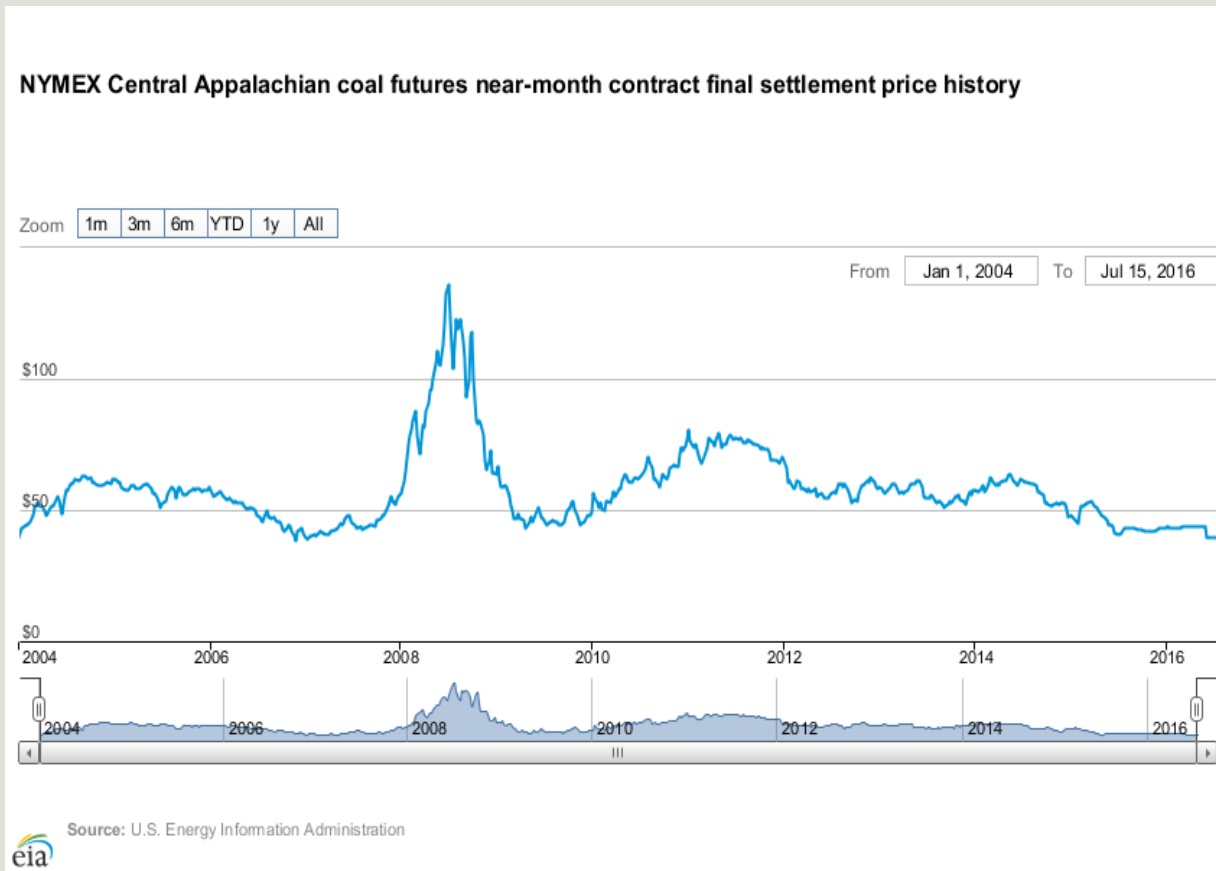
Illinois Basin

Powder River Basin

Uinta Basin



Providing Direct Evidence is Difficult



**Peak Price 6/30/08 =>
\$136/short ton**

**Low Price 11/20/06 =>
\$39/short ton**

Providing Direct Evidence is Difficult

U.S. Coal Production:

| Year | Thousand Short Tons |
|------|---------------------|
| 2010 | 1,084,368 |
| 2011 | 1,095,628 |
| 2012 | 1,016,458 |
| 2013 | 984,842 |
| 2014 | 1,000,049 |

Providing Direct Evidence is Difficult

| Market Capitalizations | 4/1/11 | 7/2/13 | 11/24/15 |
|--------------------------------|---------------|---------------|-----------------|
| Alpha Natural Resources | 7,283 | 1,177 | 4 |
| Arch Coal Inc. | 5,787 | 783 | 22 |
| Cloud Peak Energy | 1,334 | 985 | 163 |
| CONSOL Energy Inc. | 12,039 | 6,205 | 1,722 |
| Peabody Energy Corp. | 19,681 | 4,011 | 220 |
| Walter Energy Inc. | 8,509 | 675 | 3 |

Our Approach

If the coal industry is being “creatively destroyed” by other methods (e.g. wind) and/or other fossil fuels (e.g. natural gas) then legislation/regulations aimed at the coal industry would be unnecessary and the stock market would pay little notice to their enactment

Our Approach

Alternatively, if the coal industry is NOT being “creatively destroyed”, because it is CHEAP and PLENTIFUL, then legislation/regulations aimed at the coal industry would be necessary in order to eliminate its use and when enacted the stock market should react accordingly

Sample Firms

| | |
|--|-------------------|
| Start with Largest U.S. Coal Producers (2013) | 29 |
| Eliminate Privately-Held Firms | (13) |
| Eliminate Firms entering Bankruptcy Protection | (5) |
| Eliminate Firms that U.S. Coal Production is not Their Primary Business | <u>(4)</u> |
| Sample Firms used to form an Equally-Weighted Coal Industry Portfolio => (R_{Pt}) | 7 |

Five Events of Interest (1/1/14–3/31/16)

Primary Interest => Regulatory Actions:

June 2, 2014

EPA releases the initial draft of the Clean Power Plan => (D_D)

August 3, 2015

EPA releases the final version of the Clean Power Plan => (D_F)

January 15, 2016

Department of the Interior severely limits the leasing of public land for coal mining => (D_L)

Five Events of Interest (1/1/14–3/31/16)

Secondary Interest => Acts of the U.S. Supreme Court:

June 30, 2015

Supreme Court strikes down EPA's mercury rules => (D_M)

February 9, 2016

Supreme Court rules that states and companies need not begin implementing the provisions of the Clean Power Plan until it is vetted in the courts => (D_C)

Detection of a Market Reaction

Estimate the market model for January 2014 through March 2016 using daily returns/daily percentage changes

Use additional control variables in order to attribute as much explanatory power as possible to market factors or market relationships

Detection of a Market Reaction

Control Variables:

R_{Mt} => Daily return on the S&P 500

R_{CMt} => Daily return on the SPDR S&P Global Natural Resources ETF

R_{COt} => Daily return on the VanEck Market Vectors Coal ETF

δ_{Ot} => Daily percentage change in spot oil prices

δ_{Gt} => Daily percentage change in spot natural gas prices

Detection of a Market Reaction

Empirical Model =>

$$\mathbf{R}_{Pt} = \alpha_p + \beta_p \mathbf{R}_{Mt} + \beta_{CM} \mathbf{R}_{CMt} + \beta_{CO} \mathbf{R}_{COt} + \beta_O \delta_{Ot} + \beta_G \delta_{Gt} + \beta_D \mathbf{D}_D + \beta_F \mathbf{D}_F + \beta_L \mathbf{D}_L + \beta_M \mathbf{D}_M + \beta_C \mathbf{D}_C + \varepsilon_t$$

Results =>

Seven Firm Coal Industry Portfolio

| Control Variables | Test Windows | | |
|-------------------|-----------------|-----------------|-----------------|
| | (-1, +1) | (-1, 0) | (0, +1) |
| R_{Mt} | -0.654** | -0.644** | -0.651** |
| R_{CMt} | 0.638** | 0.638** | 0.625** |
| R_{COt} | 0.988** | 0.990** | 0.988** |
| δ_{Ot} | 0.149** | 0.148** | 0.157** |
| δ_{Gt} | 0.014 | 0.016 | 0.015 |

Results =>

Seven Firm Coal Industry Portfolio

| Test Variables | Test Windows | | |
|----------------|--------------|---------|---------|
| | (-1, +1) | (-1, 0) | (0, +1) |
| D_D | -0.001 | 0.003 | -0.008 |
| D_F | -0.032** | -0.031* | -0.030* |
| D_L | -0.024* | -0.012 | -0.022 |
| D_M | 0.004 | 0.029* | -0.004 |
| D_C | -0.019 | -0.031* | -0.006 |

Results => Four Firm Coal Industry Portfolio

| Control Variables | Test Windows | | |
|----------------------|----------------|----------------|----------------|
| | (-1, +1) | (-1, 0) | (0, +1) |
| R_{Mt} | -0.194 | -0.196 | -0.174 |
| R_{CMt} | 0.364** | 0.360** | 0.345** |
| R_{COt} | 0.739** | 0.747** | 0.736** |
| δ_{Ot} | 0.146** | 0.145** | 0.156** |
| δ_{Gt} | 0.024 | 0.027 | 0.023 |

Results =>

Four Firm Coal Industry Portfolio

| Test Variables | Test Windows | | |
|----------------|--------------|----------|---------|
| | (-1, +1) | (-1, 0) | (0, +1) |
| D_D | 0.003 | 0.007 | -0.005 |
| D_F | -0.029** | -0.034** | -0.029* |
| D_L | -0.026* | -0.024** | -0.020 |
| D_M | 0.003 | 0.010 | 0.001 |
| D_C | -0.035** | -0.040** | -0.025* |

Results => Conclusion

Total percentage loss for the entire three-day window surrounding all three significant events for the four-firm coal industry portfolio =>

$$((-0.029) + (-0.026) + (-0.035)) \times (3) = -27\%$$

Seems safe to conclude that “Creative Destruction” alone is NOT all that ails the Coal Industry!